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Diagnoses and habitat preferences of the immature stages of three South African species of the Xestomyza-group (Diptera: Therevidae)

by

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SYNOPSIS

Larvae and pupae of *Pentheria simplex* Lyneborg, *Microgephyra capricornis* Lyneborg and *M. stuckenbergi* Lyneborg are diagnosed and details of their morphology are figured. The habitats of the immature stages are discussed. The taxonomic separation of the three species into two genera by Lyneborg (1972) was justified on the basis of the habitat preference and morphology of the immature forms.

INTRODUCTION

Hennig (1952) observed that descriptions of larvae and pupae of the *Xestomyza*-group and other genera from the southern hemisphere would be the most important future task in the study of immature Therevidae.

In the course of collecting larvae of Therevidae in South Africa, the author came upon several which, when reared out, proved to be members of the *Xestomyza*-group. The immature stages and ecology of this entire group of Therevidae were completely unknown, and since Lyneborg (1972) had recently submitted a revisionary manuscript on the *Xestomyza*-group, an opportunity was at hand to provide information on the immature stages of the group which would immediately follow Lyneborg's paper (see preceding paper), making all of the up-to-date knowledge on the *Xestomyza*-group simultaneously available.

METHODS AND PROCEDURES

Gathering and rearing material: The collecting and rearing procedures were the same as those employed by Irwin (in press). Larvae and pupae were gathered in the field by hand scooping or shovelling the top two to three inches (50 to 80 mm) of substrate into a 20 mesh sieve and shaking vigorously until all of the finer material had been sieved out. The larger therevid larvae and the therevid pupae were removed from the remaining debris with fine forceps and placed in vials containing a small amount of the sifted substrate. The sieve was then lifted and the smaller therevid larvae were removed from the top of the sifted pile. Because therevid larvae are cannibalistic, only one larvae was placed in each vial.

The larvae and pupae were then transported to the laboratory where they were transferred to vials containing sand which had passed through a 50 mesh sieve. Each larva was checked and given water every second day and was fed two or three *Tribolium* sp. larvae every week. When a larva pupated, the date of pupation was noted and its vial was capped

with 20 mesh screen. When the adult emerged, its date was also noted and it was preserved either mounted on an insect pin or placed in Kahle's fluid for two days, then in 70% ethanol for storage. Larval and pupal exuvia accompanied the adults (wet in 70% ethanol or dry in a gelatin capsule and attached to the same pin as the adult).

Preparation of material: Emerged adults were identified by the use of the keys and descriptions in Lyneborg's paper (1972). Associated larval and pupal exuvia were softened in a 10% solution of warm KOH for about half an hour, until all the sand particles and foreign debris were easily removed and, in the case of the larval exuvium, until the exoskeleton was easily pliable. Then exuvia were immersed in water, followed by 75% ethanol, five minutes in each, after which they were placed in glycerine on a cavity slide for study and dissection. Glycerine gel in another cavity slide was heated until liquid and parts of the dissected exuvia to be drawn were placed at the desired angle into the solution and held until it solidified. Pupae were studied and drawn using a Zeiss dissecting microscope and larvae using a Zeiss compound microscope. All drawings were initially sketched with the aid of a Zeiss camera lucida. Details were added by the microscope-aided eye. Where possible several specimens were examined to determine intraspecific variation.

There is no consistent, generally accepted terminology for certain structural details of immature Therevidae. The terms used here are those employed by other workers on immatures of this family. A consideration of the basic morphology of therevid immature stages is inappropriate here, but clearly must be done in the future.

Each specimen was given a unique number to facilitate the association of data. This number appears on a yellow label together with the words in small offset print: THEREVIDAE, M. E. Irwin, Specimen #. Numbers referring to specimens will be found throughout the figures in parentheses. These numbers will also be used to incorporate the specimens in an automated data-management system (Rauch, 1970).

All linear measurements shown in the figures are in millimetres.

HABITATS OF THE *XESTOMYZA*-GROUP

Therevids inhabit environments as diverse as parched temperate desert and dank tropical cloud forest. The *Xestomyza*-group of therevids appears to be confined to the semitropical and subtropical zones of the Old and New World. Specifically, they are limited to South, Central and semitropical North America and to southern Africa from the southwestern Cape to Rhodesia (Lyneborg, 1972).

The closest living relatives of the *Xestomyza*-group belong to the *Phycus*-group and the *Rueppellia*-group (Irwin, in press). Specimens of the *Phycus*-group generally inhabit tropical to semitropical, humid environments while members of the *Rueppellia*-group generally occupy temperate to subtropical, xeric zones.

To date, three species within two African genera of the *Xestomyza*-group have been collected as larvae and reared through to adults by the author. Larvae seemingly occupy rather xeric substrates. Larvae of *Pentheria simplex* were associated with rotting wood in a mixed wood-mulch soil protected from direct rainfall by leaning tree trunks. The specimens were collected in the Karkloof Range, Natal Province, South Africa, within a temperate forest zone at an elevation of about 1 400 m. Larvae of Tenebrionidae and Scarabaeidae were in close proximity and presumably provided the major food source for the *Pentheria* larvae.

Larvae of two species of *Microgephyra* were associated with sandy substrates and were found within the semitropical coastal plain which extends southward from Moçambique along the eastern coast of Natal, South Africa. Larvae of *M. capricornis* Lyneborg were found in humus-enriched sand on the leeward side of beach dunes at Umhlanga Rocks about three metres above sea-level. They were sifted from under mangrove trees in a sheltered area. Only four larvae were collected, two of which reared out to adult *M. capricornis*. The other two died. Therevid larvae that were collected from the exposed, ocean side of the beach dunes belonged to a new genus close to *Psilocephala*.

Larvae of *M. stuckenbergi* Lyneborg were found in a humus-enriched sandy soil near Ndumu Game Reserve, in a scrub thicket (fig. 26). The dominant understory plant appeared to be a composite, *Senecio barbetonicus* Klatt, from under which the larvae were sifted. For a more detailed account of the surrounding vegetation see Stuckenberg (1966). Immatures were abundant. Thirty-three larvae and two pupae were sifted from a three feet × two feet × two inches sample under a single *Senecio barbetonicus* plant, 7 km south of Ndumu Game Reserve Camp at an elevation of 50 m. Adults were not commonly encountered, although a modified Malaise trap (*see* Irwin, in press) set up in the scrub thicket collected two males, and the author collected one male and one female in the area. One other male and two females were collected 32 km south of Ndumu Game Reserve Camp at an elevation of 100 m. The hand netted males were all resting on the tips of the upper surface of the higher leaves of *Senecio barbetonicus*, apparantly awaiting passing females. One female was collected on a lower leaf of the same species of plant. The other female was taken about 1,5 m above ground level in a small tree on the upper surface of a leaf, apparently in a night-resting stance since it was nearly dark when observed by the author. Of the larvae that were reared to adult in the laboratory, three were observed and they individually required 12, 12 and 11 days between pupation and eclusion.

These observations tend to reinforce the taxonomic separation of *Pentheria* and *Microgephyra*, the former associated with highland forest, the latter with lowland scrub.

MORPHOLOGY OF IMMATURE THEREVIDAE

Historical: Sclerotized structures of immature Therevidae have not been well defined. Of the workers who have described and named some of these structures, the following are noteworthy: Brauer (1883), Collinge (1909), Meijere (1916), Malloch (1917), Cole (1923), Isaac (1925), Bhatia (1936), Engel & Cuthbertson (1938), English (1950), Hennig (1952), Hildebrand (1952), Brauns (1954*a*, 1954*b*) and Oldroyd (1968). Meijere, English, Hennig and Brauns have given more detailed accounts of therevid structures. Synoptic accounts have been given by Hennig and Brauns. Meijere treated only the genus *Thereva*, and in a general manner. English was the first and, until now, the only worker to recognize characters and provide keys for the separation of immature stages of therevid genera.

Anthon (1943) and Anthon & Lyneborg (1968) presented detailed descriptions of the larval head capsules of certain Nematocera. Some of the structures they describe appear to be homologous with therevid larval head structures described by authors listed above.

Terminology: Most of the terms used by the workers mentioned above are self-explanatory. An alphabetical list of larval and pupal structures not immediately self-evident or not standardized among workers follows:

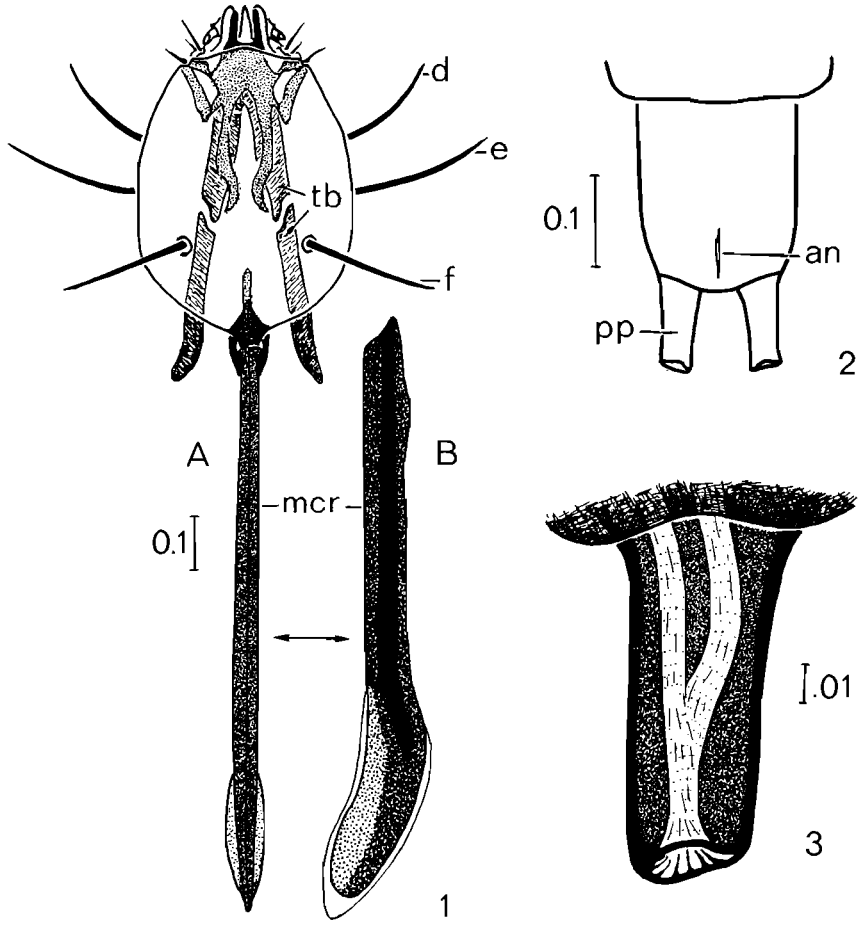
abdominal spiracles (abs), figs 9 and 10, of pupa. These spiracles are set upon elongate protubrances laterad on each abdominal segment.

anterior maxillary palp (amp), figs 4 and 5, of larva. Termed thus by English, a double set of lobes anterior to each maxillary palp.

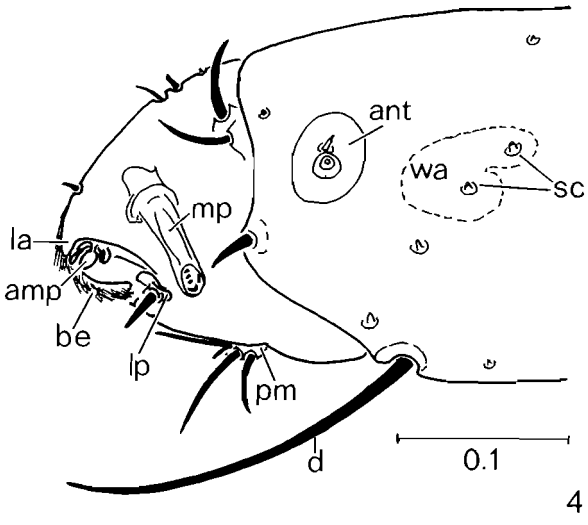
antennal sheath (ants), figs 9 and 10, of pupa. These horn-like structures cover the antennae of the developing adult.

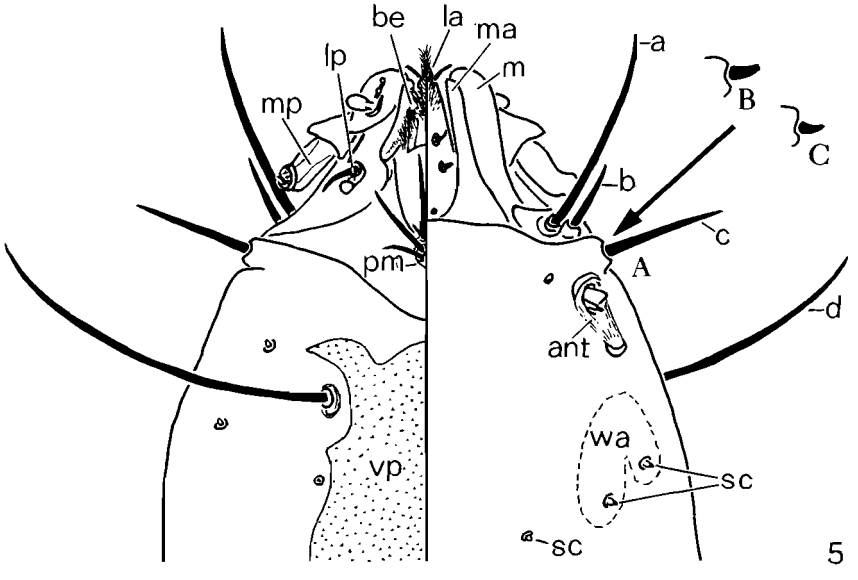
alar process (ap), fig. 10, of pupa. Formerly termed 'alar spine' by English, this process does not always appear spine-like.

anterior spiracle, fig. 6, of larva. This set of spiracles was termed 'thoracic spiracles' by Malloch and others.



Figs 1–3. 1. *Pentheria simplex* Lyneborg, ♀, (3849). Last larval instar exuvium. A. Head capsule, dorsal aspect. B. Metacephalic rod, lateral view. 2. *Microgephyra stuckenbergi* Lyneborg. Last instar larva, ventral aspect of last part of abdominal segment showing anus and pseudopods. 3. *Microgephyra stuckenbergi* Lyneborg. Pseudopod of last instar larva, ventral aspect.





Figs 4–5. 4. *Pentheria simplex* Lyneborg, ♀, (3849). Anterior portion of head capsule of last instar larval exuvium, lateral aspect. 5. A. *Pentheria simplex* Lyneborg, ♀, (3849). Anterior portion of head capsule of last instar larval exuvium, ventral aspect (left half), dorsal aspect (right half). B. *Microgephyra stuckenbergi* Lyneborg, ♀, (3872). Cephalic seta 'c', dorsal aspect. C. *Microgephyra capricornis* Lyneborg, ♂, (3867). Cephalic seta 'c', dorsal aspect.

beard of maxilla (be), figs 4 and 5, of larva. Termed thus and also 'maxillary tuft' by English. Anterior portion of ventral edge of maxilla bearing downward, backward and inward directed fine hairs.

caudal spines (cs), figs 8, 14, 15, 19, 20, 24, 25, of pupa. Also termed 'caudal filaments' by some workers, these paired structures are characteristic of all known therevid pupae.

cephalic setae 'a', 'b', 'c', 'd', 'e', 'f' (figs 1A, 4 and 5) of larva. The only cephalic seta previously named was 'a' and it was termed 'anterior dorsal hair' by English. Cephalic seta 'c' was drawn on posterior edge of anterior portion of the head capsule by English. The author found this situated on the anterior edge of the posterior portion of the head capsule.

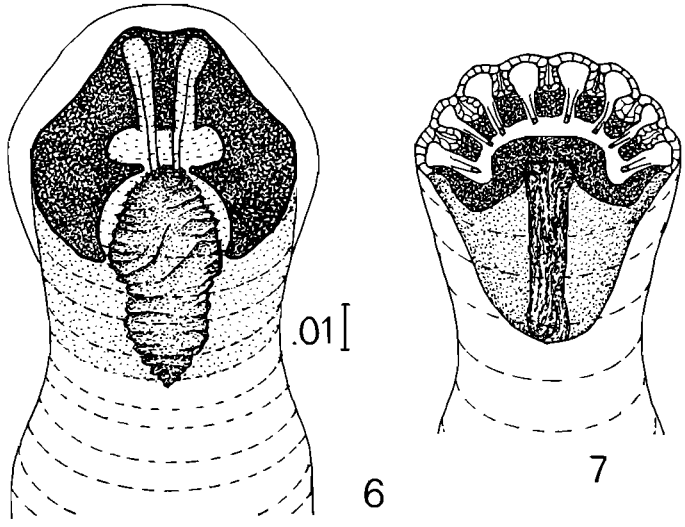
labial palp (lp), figs 4 and 5, of larva. The most obvious portion of this structure is the thickened spine, but it also appears to have an elongate base when viewed under a compound microscope at powers greater than 250×.

labral sheath (las), figs 9, 12, 17, 22, of pupa. A medio-ventral raised shield of the pupal exoskeleton, under which the labrum of the adult develops.

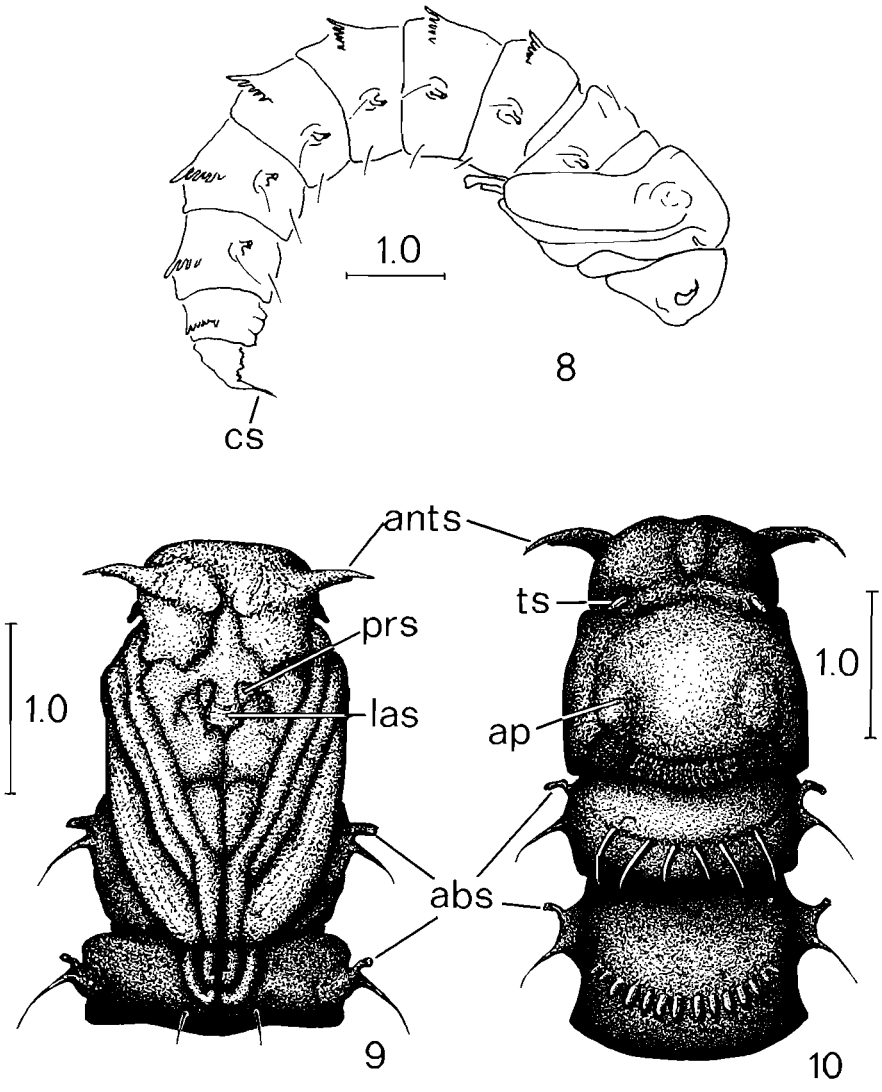
metacephalic rod (mcr), figs 1A and 1B, of larva. Also termed 'median rod' by Engel & Cuthbertson and 'capsule rod' by English.

prementum (pm), figs 4 and 5, of larva. Termed thus by English and Meijere, a ventral base which bears three pairs of setae.

proboscial sheath (prs), figs 9, 12, 17, 22, of pupa. Termed thus by English, a pair of medio-ventral raised shields of the pupal exoskeleton, under which the proboscis of the adult develops.

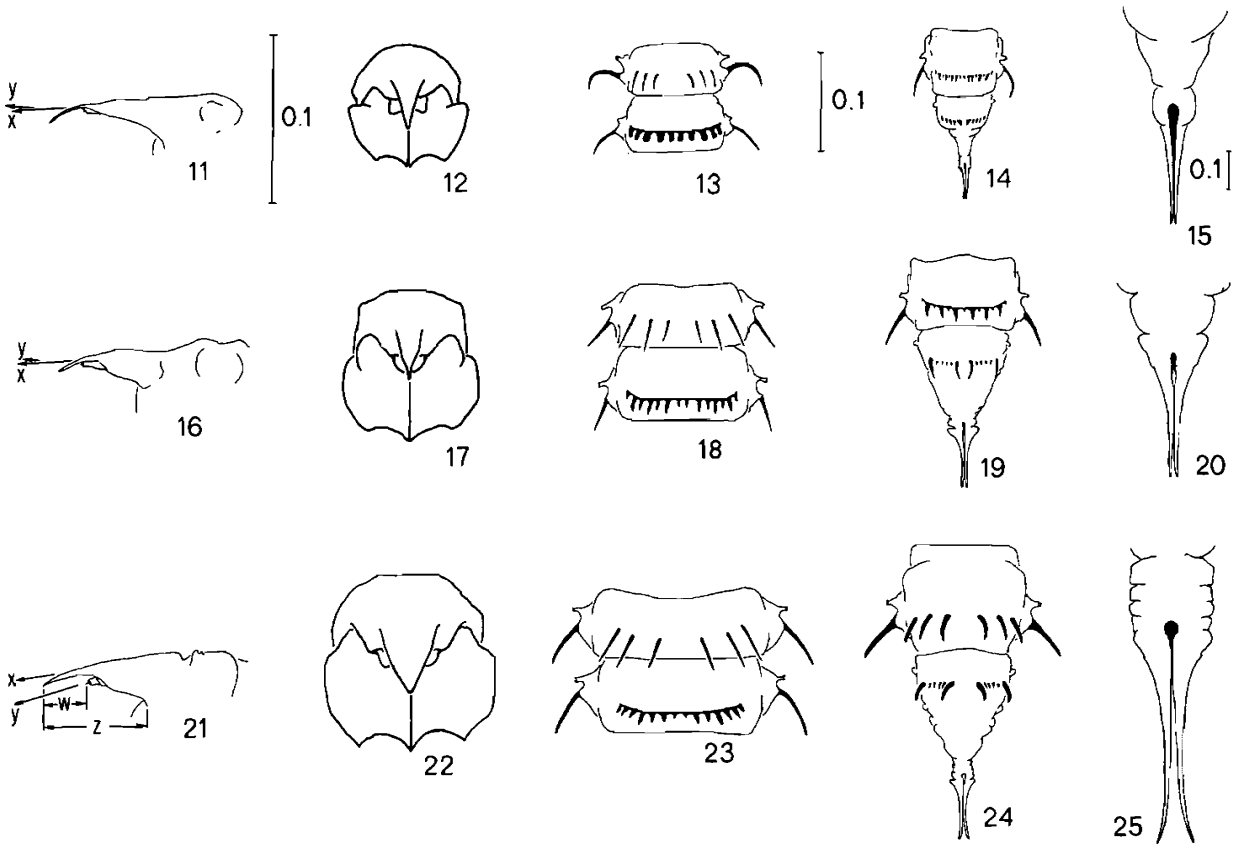


Figs 6–7. *Pentheria simplex* Lyneborg, ♀, (3849). Last instar larval exuvium. 6. Anterior spiracle. 7. Posterior spiracle.



Figs 8–10. *Microgephyra stuckenbergi* Lyneborg, ♀, (3872), Pupa. 8. Entire pupa, lateral aspect. 9. Head, thorax and abdominal segments I–II, ventral aspect. 10. Head, thorax, abdominal segments I–II, dorsal aspect.

pseudopod (pp), figs 2 and 3, of larva. Also termed 'posterior pseudopod' by English and Isaac, styliform bodies by Collinge, prolegs by Bhatia, and small fleshy processes by Engel & Cuthbertson. While their function is uncertain, English states that they are continuously used for locomotion when turned downwards at right angles to the body. She further suggests the pseudopods are able to grip surfaces by creating a suction.



Figs 11–25. Pupal characters. 11–15. *Microgephyra capricornis* Lyneborg, ♂, (3867). 16–20. *Microgephyra stuckenbergi* Lyneborg, ♀, (3872). 21–25. *Pentheria simplex* Lyneborg, ♀, (3849). 11, 16, 21. Antennal sheath, ventral aspect. 12, 17, 22. Labral sheaths and proboscial sheaths, ventral aspect. 13, 18, 23. Abdominal segments I and II, dorsal aspect. Abdominal segments VII–VIII, dorsal aspect. 15, 20, 25. Caudal spines, dorsal aspect.

sensory cell (sc), figs 4 and 5, of larva. Termed 'papillae' by English, 'cornea-like structures of the eye spots' by Hennig, each 'sensory cell' or 'sensory pit' contains a slightly projecting peg-like seta, and these 'sensory cells' can be found over the dorsal and lateral portions of the larval head capsule. Two such 'sensory cells' occur on each side of the head capsule in the white area (wa) (see below), and are presumed to be light receptors.

tentorial bar (tb), fig. 1A, of larva. This sclerotised bar within the head capsule consists of two parts, the forepart which appears fused anteriorly and the hind part (one bar per side) free and projecting into the prothorax.

white area (wa), figs 4 and 5, of larva. Termed thus by English, this non-pigmented area on the lateral portion of the larval head capsule contains two sensory cells which presumably function as light receptors.

IMMATURE FORMS OF THE *XESTOMYZA*-GROUP

The immature forms of the *Xestomyza*-group are very similar in structure to all other known immature forms of Therevidae. Descriptions of the generalized therevid larva and pupa can be found in most of the papers cited above. For this reason, only diagnoses are given for the taxa involved, and these will be subject to change when more is known of the immatures of Therevidae in general and the *Xestomyza*-group in particular.

Xestomyza-group

Egg—Unknown.

Larva—The larvae of Therevidae appear to be extremely similar, regardless of taxon viewed. From the representatives of a few genera dissected by the author and from literature accounts, the following combination of characters should serve to delimit the larvae of the *Xestomyza*-group from most other therevid larvae (with the possible exceptions of the larvae of the *Rueppellia*-group and the *Phycus*-group): anterior pair of setae of prementum directed forward, reaching well past base of labial palps (figs 4 and 5); cephalic seta 'c' set on anterior edge of the posterior portion of head capsule (fig. 5); posterior portion of metacephalic rod of head capsule deeper than wide (figs 1A and 1B); posterior spiracles with eight chambers (fig. 7); posterior pseudopods elongate and blunt (figs 2 and 3).

Pupa—The pupae of the *Xestomyza*-group are generally more elongate than those of other groups of therevids (with the exception of the *Phycus*-group). Pupae can be distinguished by the following combination of characters: alar process not spinose (fig. 9); proboscial sheath entirely bisected by labral sheath (figs 9, 12, 17, 22); dorsal spines of at least abdominal segments II through IV heavily sclerotized and fused basally (figs 10, 13, 18, 23).

Genus *Pentheria* Kröber

Larva—Only one larval character was found that could separate *Pentheria* and *Microgephyra*: cephalic seta 'c' longer than cephalic seta 'b' (fig. 5).

Pupa—The pupae of *Pentheria* can be distinguished from those of *Microgephyra* by the following combination of characters: extended line along antennal sheath (x) and extended line along tubular, apparently segmented, setal tipped sense organ of antennal

sheath (y) divergent (fig. 21); ratio of distance between outer margin of tubular sense organ of antennal sheath and apex of antennal sheath (w) to outer edge of head capsule and apex of antennal sheath (z) greater than 0,35 : 1 (0,40 : 1 for *P. simplex*) (fig. 21); labral sheath wide, broadly bisecting proboscial sheath and extending well below posterior margin of proboscial sheath (fig. 22); six spines on dorsum of abdominal segment VII, all of nearly equal length and well separated from one another (fig. 24); caudal spines strongly divergent at apex (fig. 25).

Pentheria simplex Lyneborg

Since only one species is at hand, no attempt will be made to diagnose the immature stages of this species.

Genus *Microgephyra* Lyneborg

Larva—Only one larval character was found that could separate *Microgephyra* and *Pentheria*: cephalic seta 'c' shorter than cephalic seta 'b' (fig. 5).

Pupa—The pupae of *Microgephyra* can be distinguished from those of *Pentheria* by the following combination of characters: extended line along antennal sheath (x) and extended line along tubular, apparently unsegmented, setal tipped sense organ of antennal sheath (y) convergent (figs 11, 16); ratio of distance between outer margin of tubular sense organ of antennal sheath and apex of antennal sheath (w) to outer edge of head capsule and apex of antennal sheath (z) less than 0,35 : 1 (0,31 : 1 for *M. capricornis*, 0,27 : 1 for *M. stuckenbergi*) (figs 11, 16, 21); labral sheath narrow, not protruding far beyond posterior margin of proboscial sheath (figs 12, 17); more than 12 spines on dorsum of abdominal segment VII, some of which may be minute (figs 14, 19); caudal spines narrowly divergent apically (figs 15, 20).

Microgephyra capricornis Lyneborg

Larva—The larvae of *M. capricornis* can be distinguished from those of *M. stuckenbergi* by the possession of a short, pointed cephalic seta 'c' (fig. 5C).

Pupa—The pupae of *M. capricornis* can be distinguished from those of *M. stuckenbergi* by the following combination of characters: antennal sheath narrow, its tip elongate (fig. 11); abdominal segments II, III and IV with heavily thickened, evenly sized dorsal spines (fig. 13); abdominal segments V, VI and VII, with less thickened, more evenly sized spines (fig. 14); spines on dorsum of abdominal segment VIII, while somewhat uneven, more uniform than those of *M. stuckenbergi* (fig. 14); caudal spines thinner, less divergent than those of *M. stuckenbergi* (fig. 15).

Microgephyra stuckenbergi Lyneborg

Larva—The larvae of *M. stuckenbergi* can be distinguished from those of *M. capricornis* by the possession of a short, blunt cephalic seta 'c' (fig. 5B).

Pupa—The pupae of *M. stuckenbergi* can be distinguished from those of *M. capricornis* by the following combination of characters: antennal sheath blunt, broad (fig. 16); abdominal segments II through VII with moderately thickened spines on dorsum, the spines being of unequal length (figs 18, 19); spines on the dorsum of abdominal segment VII alternately

Fig. 26. Thorny scrub thicket, 7 km south of Ndumu Game Reserve Camp, Natal, where specimens of *Microgephyra stuckenbergi* Lyneborg were collected. Adults were found in shady areas on the shrubs of *Senecio barbetonicus* Klatt, located on the right and left sides close to ground level in the photograph. Larvae and pupae were found in the top two inches of sand under the right-hand specimen of *S. barbetonicus*; none were found under the sand in the open sunny areas.

large, thick to small, fine (fig. 19); dorsum of abdominal segment VIII with four small spines between each of two pairs of long, somewhat thickened spines (fig. 19); caudal spines slightly more divergent than those of *M. capricornis* (fig. 20).

CONCLUSIONS

Immatures of the *Xestomyza*-group occur in arid parts of the environment, in close association with a humus-enriched substrate. While immatures of the genus *Pentheria* occupy a wood-mulch substrate in temperate forest ecosystems, immatures of the genus *Microgephyra* are associated with a sandy substrate in low-lying coastal scrub ecosystems.

Immatures of all Therevidae are remarkably similar in appearance. Assessment of a series of minute characters was necessary in order to separate larvae of the *Xestomyza*-group from those of other groups, and only a single character was found to separate genera and species within the *Xestomyza*-group. The pupae however, have a wider variety of characters which enabled the author to more easily separate species, genera, and groups within the Therevidae.

The taxonomic arrangement of the three species based on adult morphology by Lyneborg (1972) appears justified on the basis of the habitat preference and morphology of members of the immatures of the *Xestomyza*-group herein reported.

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LIST OF ABBREVIATIONS FOR ILLUSTRATIONS

a	cephalic seta 'a' on antero-lateral surface of head capsule.
abs	abdominal spiracles
amp	anterior maxillary palps
an	anus
ant	antenna
ants	antennal sheath
ap	alar process
b	cephalic seta 'b' on antero-lateral surface of head capsule
be	beard of maxilla
c	cephalic seta 'c' on centro-lateral surface of head capsule
cs	caudal spines
d	cephalic seta 'd' on medio-ventral surface of head capsule
e	cephalic seta 'e' on medio-ventral surface of head capsule
f	cephalic seta 'f' on postero-dorsal surface of head capsule
la	labrum
las	labral sheath
lp	labial palp
m	maxilla
ma	mandible
mcr	metacephalic rod
mp	maxillary palp
pm	prementum
pp	pseudopod
prs	proboscial sheath
sc	sensory cell
tb	tentorial bars
ts	thoracic spiracles
vp	ventral plate
wa	white area

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